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THREAD RUBBER FOR GOLF BALLS

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(57) Disclosed is thread rubber for golf balls, which has good aging resistance and rebound characteristics, and to a thread wound golf ball using the thread rubber. The thread rubber for golf balls is characterized in that a retention of tensile strength after aging 7 days at 70 °C is not less than 70 %, a hysteresis loss at a 100 Kg/cm² constant stress tensile is not more than 50 % and an elongation at a 100 Kg/cm² constant stress elongation is within the range of 900 to 1400 %.

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ABSTRACT OF THE DISCLOSURE

Disclosed is thread rubber for golf balls, which has good aging resistance and rebound characteristics, and to a thread wound golf ball using the thread rubber. The thread rubber for golf balls is characterized in that a retention of tensile strength after aging 7 days at 70 °C is not less than 70 %, a hysteresis loss at a 100 Kg/cm² constant stress tensile is not more than 50 % and an elongation at a 100 Kg/cm² constant stress elongation is within the range of 900 to 1400 %.

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COMPLETE SPECIFICATION

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INVENTION TITLE:

Thread rubber for golf balls

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

FIELD OF THE INVENTION

The present invention relates to thread rubber for golf balls and a thread wound golf ball using the thread rubber. Particularly it relates to 5 thread rubber for golf balls, which has good aging resistance and rebound characteristics, and to a thread wound golf ball using the thread rubber.

BACKGROUND OF THE INVENTION

Thread wound golf balls are generally used by many golfers, especially high level golfers, because the balls have excellent shot feel, 10 good controllability and good rebound characteristics. The thread wound golf ball is composed of a center, a thread rubber layer formed on the center and a cover formed on the thread rubber layer, and the thread rubber layer is formed by winding thread rubber around the center at an elongation of about 15 800 to 1000 % and imparts rebound characteristics and suitable compression strength (compression) to the resulting golf balls.

The thread rubber is conventionally formed from a blend of a high-cis polyisoprene rubber, such as natural rubber, and a synthetic low-cis polyisoprene rubber, because the low-cis polyisoprene rubber gives high 20 rebound characteristics and the high-cis polyisoprene rubber gives high strength and compression stability to temperature. Although the compression gradually reduces at a temperature of more than room temperature, the high-cis polyisoprene effectively inhibits the reduction.

If the content of the low-cis polyisoprene rubber is made larger,

the thread rubber increases rebound characteristics, but strength and compression stability would reduce and are not suitable for practical use. It is therefore difficult to keep the balance between rebound characteristics and strength or compression stability to temperature in thread rubber for golf balls.

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SUMMARY OF THE INVENTION

The present invention has made to satisfy the above desire and provides thread rubber for golf balls characterized in that a retention of tensile strength after aging 7 days at 70 °C is not less than 70 %, a hysteresis loss at a 100 Kg/cm² constant stress tensile is not more than 50 % and an elongation at a 100 Kg/cm² constant stress elongation is within the range of 900 to 1400 %.

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The present invention also provides a thread wound golf ball of which a thread rubber layer is formed from the above thread rubber.

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DETAILED DESCRIPTION OF THE INVENTION

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The retention of tensile strength, hysteresis loss and elongation are determined by the following method. A sample of thread rubber having width 1.6 mm X thickness 0.5 mm X and a suitable length is equipped with a tensile strength tester to adjust its length to be tested to 22 mm and drawn at a drawing rate of 500 mm/min. The retention of tensile strength is a value of a tensile strength after aging 7 days at 70 °C divided with a tensile strength before aging, which times 100, and is expressed in percentage. The hysteresis loss is determined from Fig. 1 which shows a hysteresis curve of

stress-strain when a sample of the thread rubber is stretched at a tensile rate of 500 mm/min until 100 Kg/cm² constant stress by a tensile strength tester (Curve a in Fig. 1) and then restored to its original state (Curve b in Fig. 1). The hysteresis loss is a value of energy loss (W_1) divided with supply energy ($W_1 + W_2$) and is indicated in the unit of percentage.

$$\text{Hysteresis loss (\%)} = \frac{W_1}{(W_1 + W_2)} \times 100$$

Elongation is a strain amount at 100 Kg/cm² tensile force, that is the point (c), and is determined from the following equation in the unit of percentage.

Elongation (%) = [(stretched length/original length) - 1] X 100

The thread rubber of the present invention has a hysteresis loss of not more than 50 %, preferably not more than 45 % and preferably not less than 10 %, more preferably not less than 38 %. The thread rubber also has an elongation of 900 to 1,400 %, preferably 950 to 1,300 %, more preferably 1,000 to 1,150 %. If the hysteresis loss is more than 50 % or the elongation is less than 900 %, the thread rubber does not have sufficient rebound characteristics. If the elongation is more than 1400 %, the thread rubber is difficult to wind on the center and reduces compression, thus resulting in poor rebound characteristics. If the hysteresis loss is less than 10 %, the thread rubber is usable for the golf ball, but tends to reduce compression, thus resulting in poor rebound characteristics.

The thread rubber of the present invention also has a retention of tensile strength of not less than 70 % after aging 7 day at 70 °C. This feature governs compression stability of the resulting golf ball. If the retention is less than 70 %, the compression of the golf balls would reduce

and would not be suitable for practical use.

The thread rubber of the present invention can be anyone as long as the above three features are met, but typical rubber composition and method for production are explained hereinafter.

5 The thread rubber may be obtained by vulcanizing a rubber composition which generally contains a rubber component and a vulcanizing agent.

The rubber component can generally be a polyisoprene rubber which is drawn and crystallized to form a thread rubber layer having high hardness. The rubber component may also include unsaturated rubber, such as polybutadiene rubber, styrene-butadiene rubber, ethylene-propylene rubber. The polyisoprene rubber is generally classified into high-cis polyisoprene rubber having a cis content of 98 % or more, such as natural rubber, deproteinized natural rubber, synthetic high-cis polyisoprene rubber and the like; and low-cis polyisoprene rubber having cis content of less than 98 %, such as Kariflex IR 309 having a cis content of about 92 % and trans content of about 8 % available from Shell Chemical Co. A mixture of the high-cis polyisoprene rubber and the low-cis polyisoprene rubber is generally employed considering the balance of strength and rebound characteristics, because the high-cis polyisoprene rubber is good for strength and the low-cis polyisoprene rubber is good for rebound characteristics.

As mentioned above, when the blend of the high-cis polyisoprene rubber and low-cis polyisoprene rubber is employed, rebound characteristics enhance while strength retention adversely reduces. In order

to improve the strength retention, it is proposed to formulate zinc oxide in the rubber composition. Zinc oxide is generally contained in an amount of 0.1 to 1.0 parts by weight based on 100 parts by weight of the rubber component. Amounts of less than 0.1 part by weight do not improve strength retention 5 sufficiently and those of more than 1.0 part by weight reduce elongation and adversely affect on rebound characteristics.

When the rubber component mainly contains the high-cis polyisoprene rubber, such as natural rubber or deproteinized natural rubber, disulfides may preferably be added to the rubber composition to improve 10 rebound characteristics. The disulfides include diphenyl disulfide or dinaphthyl disulfide, having one or more amino groups as substituents, which effectively enhances rebound characteristics and retention of tensile strength.

Typical examples of the disulfide are bis(2-aminophenyl) disulfide, bis(4-aminophenyl) disulfide, bis(3-aminophenyl) disulfide, 2,2'-bis(1-aminonaphthyl) disulfide, 2,2'-bis(3-aminonaphthyl) disulfide, 2,2'-bis(4-aminonaphthyl) disulfide, 2,2'-bis(5-aminonaphthyl) disulfide, 2,2'-bis(6-aminonaphthyl) disulfide, 2,2'-bis(7-aminonaphthyl) disulfide, 2,2'-bis(8-aminonaphthyl) disulfide, 1,1'-bis(2-aminonaphthyl) disulfide, 1,1'-bis(3-aminonaphthyl) disulfide, 1,1'-bis(4-aminonaphthyl) disulfide, 1,1'-bis(5-aminonaphthyl) disulfide, 1,1'-bis(6-aminonaphthyl) disulfide, 1,1'-bis(7-aminonaphthyl) disulfide, 1,1'-bis(8-aminonaphthyl) disulfide, 1,2'-diamino-1',2-dithiodinaphthalene, 2,3'-diamino-1,2'-dithiodinaphthalene 20 and the like. Preferred are bis(2-aminophenyl) disulfide, 2,2'-bis(8-aminonaphthyl) disulfide, 1,1'-bis(2-aminonaphthyl) disulfide and 1,1'-bis(4-

aminonaphthyl) disulfide.

In order to improve heat resistance of the thread rubber of the present invention, it is preferred that the sulfide is combined with zinc oxide.

The rubber employed in the present invention can either be
5 solid type rubber or latex type rubber. The latex rubber contains rubber
particles colloidally dispersed in aqueous solution. Latex rubber is preferred
for the present invention, because the resulting thread rubber has higher
strength.

The rubber composition may contain an antioxidant. Examples
10 of the antioxidants are phenol compounds, such as 2,2'-methylenebis-(4-
ethyl-6-t-butylphenol), 2,2'-methylenebis-(4-methyl-6-t-butylphenol), 2,6-di-t-
butyl-4-methylphenol, 4,4'-thiobis-(6-t-butyl-3-methylphenol), tetrakis-
15 [methylene-3-(3',5'-di-t-butyl-4'-hydroxyphenyl)propionate]methane and the
like. An amount of the antioxidant can be 0.1 to 5 parts by weight, based on
100 parts by weight of the rubber component.

The rubber component may further contain a vulcanizing agent,
a vulcanization accelerator, a filler, oil and the like, in addition to the above
mentioned components. The vulcanizing agent can generally be sulfur, a
sulfur compound except the disulfide or a peroxide (e.g. dicumyl peroxide).

20 The vulcanization accelerator used in the present invention can
be anyone which has been used for the vulcanization of the thread rubber
for golf balls. Typical examples thereof are butyl aldehyde-aniline
condensate (available from Ohuchi Shinko Chemical K.K. as Noccelar 8),
25 diphenylguanidine (DPG), benzothiazole (M), dibenzothiadyl disulfide (DM),
n-cyclohexyl-2-benzothiazole sulfenamide (CZ), n-t-butyl-2-benzothiazole

sulfenamide (NS) and the like. The accelerator may be contained in the rubber composition in an amount of 0.1 to 5 parts by weight, based on 100 parts by weight of the rubber component.

Typical examples of the fillers are kaoline, clay, calcium carbonate and the like. The oil includes naphthenic oil, dioctyl adipate, dioctyl azelate, isoctyl tallate and the like. The amount of the filler may be within the range of 0 to 5 parts by weight, based on 100 parts by weight of the rubber component. The amount of the oil may be within the range of 0 to 10 parts by weight, based on 100 parts by weight of the rubber component.

The thread rubber may be prepared by mixing the above mentioned components in a mixer (e.g. a kneader or a Banbury mixer) and then extruding it in the form of sheet having a thickness of about 0.5 mm, followed by vulcanizing at a temperature of 100 to 200 °C for 15 to 240 minutes. The resulting vulcanized sheet is cut into threads having a width of 1 to 2 mm.

A thread wound golf ball can be produced using the above obtained thread rubber. The thread rubber is wound on a center to form a thread wound core. The length of the thread rubber wound on the center is not limited, but can be within the range of 4 to 8 m. The center can be one which has used for thread wound golf balls, such as a solid center formed from a vulcanized rubber and a liquid center composed of a rubber bag and liquid encapsulated in the rubber bag. The rubber for the solid center is known to the art, and may contain butadiene rubber, filler, peroxide vulcanizing agent and the like. The liquid used for the liquid center may be water, or an aqueous paste containing filler. The thread wound core is then

covered with a cover material selected from the group consisting of ionomer resin and transpolyisoprene (balata). When forming a cover, many depressions called "dimples" are generally formed on the cover for controlling air resistance when flying. The golf ball having a dimpled cover is then coated with paint to finish for serving commercial sell.

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EXAMPLES

The present invention will be illustrated by Examples which, however, are not to be construed as limiting the present invention to their details.

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Examples 1 to 5 and Comparative Examples 1 to 4

(Preparation of latex compositions)

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Nine kinds of latex compositions were prepared from the ingredients shown in Tables 1 and 2 by mixing. In Tables 1 and 2, the numbers show parts by weight and in case of latex, it shows an amount of rubber content. The other components are shown in an amount of effective component. Details of the formulated chemicals are shown after Table 2.

Table 1

Example number	1	2	3	4	5
Rubber component (a)					
IOTEX C-60 (60%) *1	40	30	-	-	100
Deproteinized natural rubber latex (60 %) *2	-	-	100	100	-
Maxprene IR latex (65%) *3	60	70	-	-	-
Vulcanization accelerator (emulsion; effective component 20 %) *4	1.0	1.0	1.0	1.0	1.0
Sulfur (dispersion; effective component 50 %)	2.0	2.0	2.5	2.7	2.5
Antioxidant (dispersion: effective component 40 %) *5	1.0	1.0	1.0	1.0	1.0
Zinc oxide (dispersion: effective component 50 %)	0.5	0.5	0.5	-	0.5
Bis(2-aminophenyl) disulfide (dispersion, effective component 33.3 %) *6	-	-	2.0	2.0	3.0

Table 2

Comparative Example number	1	2	3	4
Rubber component (a)				
IOTEX C-60 (60%) *1	40	30	100	-
Deproteinized natural rubber latex (60 %) *2	-	-	-	100
Maxprene IR latex (65%) *3	60	70	-	-
Vulcanization accelerator (emulsion; effective component 20 %) *4	1.0	1.0	1.0	1.0
Sulfur (dispersion; effective component 50 %)	2.5	2.5	2.5	2.5
Antioxidant (dispersion; effective component 40 %) *5	1.0	1.0	1.0	1.0
Zinc oxide (dispersion; effective component 50 %)	-	-	-	-
Bis(2-aminophenyl) disulfide (dispersion, effective component 33.3 %) *6	-	-	-	-

*1 IOTEX C-60: High ammonia preserved natural rubber latex available from Malaysia IOI.

*2 Deproteinized ammonia preserved natural rubber latex having a non-rubber content of less than 0.1 % by weight.

*3 Maxprene IR: Low cis-polyisoprene rubber latex available from Sumitomo Seika Chemicals Co., Ltd.

*4 Butyl aldehyde-aniline condensate available from Ohuchi Shinko Kagaku K.K. as Noccelar 8.

*5 2,2'-Methylenebis-(4-ethyl-6-t-butylphenol) available from

Yoshitomi Pharmaceutical Industries, Ltd.

*6 An organic disulfide compound having a melting point of 93

°C

(Preparation of thread rubber)

5 Each latex composition according to the ingredients shown in Examples 1-5 and Comparative Examples 1-4 was solidified on an endless belt on which a solidifying solution of an aqueous calcium chloride was coated, to form a sheet. The sheet was dried and then rolled up on a drum which was vulcanized at 135 °C for 2 hours in a vulcanizer to form a

10 vulcanized rubber sheet having width 250 mm X thickness 0.5 mm X length 50 m. It was then cut into width 1.6 mm to form thread rubber. The resulting thread rubber was subjected to an evaluation of hysteresis loss (%), elongation at 100 Kg/cm² tensile force and retention of tensile strength, and their results are shown in Tables 3 to 4.

15 (Preparation of thread wound golf balls)

The thread rubber obtained above was wound on a solid center of polybutadiene vulcanized rubber having a diameter of 28.3 mm, a JIS-A hardness of 75 and a weight of 20.5 g in a drawn condition to form a thread wound core having a diameter of about 39.9 mm. It was then covered with an ionomer cover containing ionomer resin and titanium oxide, on which painting and marking were provided to form a thread wound golf ball having a diameter of about 42.7 mm. The ionomer resin was a mixture of Hi-milan 1605 and Hi-milan 1706 in 40/60 weight ratio, both Hi-milans being available from Mitsui Du Pont Polychemical Co., Ltd. and the resulting golf ball had a ball weight of 45.4 to 45.6 g. The resulting thread wound golf ball

was subjected to an evaluation of initial velocity for rebound characteristics and compression stability. The results are shown in Tables 3 to 4.

(Method of test)

5 (1) Initial velocity of balls determined by the R & A initial velocity measuring method.

(2) Compression stability of balls

The golf balls obtained were kept in an oven at 70 °C for 72 hours, after which compressions of the aged balls were measured according to the PGA method. Before the aging test, compressions were determined 10 by the PGA method and the difference between before and after the aging test is shown as test data. In data, the minus (-) expression shows that the compression reduced after the aging test.

Results of the tests

Table 3

Example number	1	2	3	4	5
Hysteresis loss (%)	45	40	41	38	43
Elongation (%)	1000	1100	1100	1150	1050
Retention of tensile strength	90	85	85	80	85
Initial velocity (feet/sec)	252.3	252.8	252.7	253.0	252.5
Compression before aging test	80	80	80	80	80
Difference of compression between before and after the aging test	-9	-10	-10	-11	-10

Table 4

Comparative Example number	1	2	3	4
Hysteresis loss (%)	43	38	60	55
Elongation (%)	1050	1150	800	850
Retention of tensile strength	50	45	85	80
Initial velocity (feet/sec)	252.5	253.0	250.0	250.5
Compression before aging test	80	80	80	80
Difference of compression between before and after the aging test	-19	-20	-10	-11

As is apparent from the above results, the thread rubbers of Examples 1-5 are good in rebound characteristics and compression stability in comparison with the thread rubbers of Comparative Examples 1-4, and 5 satisfy the required performance of golf balls.

The thread rubber of the present invention controls retention of tensile strength, hysteresis loss and elongation to specified ranges, whereby the resulting golf balls are excellent in rebound characteristics and compression stability.

10 Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Thread rubber for golf balls characterized in that a retention of tensile strength after aging 7 days at 70 °C is not less than 70 %, a hysteresis loss at a 100 Kg/cm² constant stress tensile is not more than 50 % and an elongation at a 100 Kg/cm² constant stress elongation is within the range of 900 to 1400 %.

2. The thread rubber for golf balls according to claim 1 being obtained by vulcanizing a rubber composition comprising a rubber component made of a mixture of high-cis polyisoprene rubber and low-cis polyisoprene rubber, a vulcanizing agent, zinc oxide and an antioxidant.

3. The thread rubber for golf balls according to claim 1 being obtained by vulcanizing a rubber composition comprising a rubber component made of high-cis polyisoprene rubber, a vulcanizing agent, an antioxidant and a diphenyl or dinaphthyl disulfide having one or more amino groups as substituents.

4. A thread wound golf ball comprising a center, a thread rubber layer formed on the center and a cover formed on the thread rubber layer, wherein the thread rubber layer is formed from thread rubber characterized in that a retention of tensile strength after aging 7 days at 70 °C is not less than 70 %, a hysteresis loss at a 100 Kg/cm² constant stress tensile is not more than 50 % and an elongation at a 100 Kg/cm² constant stress elongation is within the range of 900 to 1400 %.

- 15 -

5. A thread rubber for golf ball, or a golf ball incorporating same, substantially as hereinbefore described with reference to the drawings and/or Examples, excluding the comparative Examples.

DATED this 26th day of APRIL, 2000
Sumitomo Rubber Industries, Ltd. AND Sumitomo Seika Chemicals Co., Ltd.

By DAVIES COLLISON CAVE
Patent Attorneys for the Applicants

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Fig. 1

